

**DISPARATE MECHANISMS OF GROWTH AND OSMOREGULATION
IN COMMERCIALLY IMPORTANT TELEOSTS**

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Introduction

Recent studies have shown that the pituitary hormones, growth hormone (GH), prolactin (PRL), and the insulin-like growth factors, play well-defined roles in teleost osmoregulation and growth. However, there is a large degree of functional overlap among these hormones. As a consequence, it is often difficult to study the endocrine regulation of a single physiological process without considering how these hormones simultaneously influence other physiological sectors. Adding to this complexity are environmental, physiological, nutritional and social factors that influence levels of these hormones in fish. The idea that a single hormone (e.g., PRL) can regulate multiple physiological pathways suggests that alterations in its regulation may impact these pathways in unpredictable ways. For example, changes in aspects of water quality (salinity), during critical life-history stages, can alter levels of GH and PRL thus affecting growth and development (e.g., stunting in salmonids) in economically-important teleosts.

The endocrine regulation of growth and adaptation in yellow perch (*Perca flavescens*) and channel catfish (*Ictalurus punctatus*) are poorly understood and efforts in our laboratory are thusly focused on characterizing these endocrine pathways. Presently, we are developing the endocrine tools needed to study the estrogen-dependent (Malison *et al.*, 1985), sexually-dimorphic growth patterns (females grow faster and larger than males) seen in yellow perch. As for channel catfish, we (Tang *et al.*, 2001) have recently shown that GH and PRL mRNA levels change in predictable ways when exposed to different salinities. However, we have not been able to show that GH has any hypoosmoregulatory actions in this teleost (Eckert *et al.*, 2001; Tang *et al.*, 2001). Consequently, the

significance of elevated GH mRNA levels (osmoregulatory actions of GH) following transfer to 8 ppt saline water (Tang *et al.*, 2001) is unknown. Further still, the growth-promoting actions of heterologous GH in channel catfish are not consistent with those reported in other teleosts (Wilson *et al.*, 1988). Against this background, we are studying the endocrine physiology of growth and adaptation in both species. Herein, we report preliminary findings in channel catfish.

Methods:

In vivo Experiments:

Animals were held in flow-through fresh water and given intraperitoneal injections of vehicle (corn oil) alone or vehicle containing the GH secretagogues KP-102 (D-Ala-D-*B*-Nal-Ala-Trp-D-Phe-Lys-NH₂) (Kaken Pharmaceuticals, Tokyo, Japan) or bGHRH₁₋₂₉-amide (Sigma Chemical, St. Louis, MO) at a dose of 100 ng/g bw. Recombinant bGH (bovine GH) and bPL (bovine placental lactogen) (Monsanto, St. Louis, MO) were administered at a dose of 1 µg/g bw. Injections were given every 6 days for 18 days.

Seven days after the third injection, ½ of the animals were sampled for plasma. Remaining animals were transferred to 15 ppt seawater (SW) over the course of forty-eight hours by diluting natural SW with fresh municipal water. Animals were sampled for plasma twenty-four hours after the adjustment to 15 ppt SW. Plasma osmolality was determined using a vapor pressure osmometer (Wescor, Logan, Utah), whereas plasma GH levels were determined using a newly developed, homologous, ELISA.

Results and Discussion:

The effects of rbGH and rbPL, KP-102 and bGHRH on the growth, osmoregulatory and endocrine physiology of channel catfish were examined. We found that rbGH and rbPL significantly elevated body weight when compared with controls, whereas the GH secretagogues appeared to reduce body weight (data not shown). The osmoregulatory response of treated channel catfish (in 15 ppt SW) was unexpected (Figure 1). Compared with control values, all the treatment groups displayed significant increases in plasma osmolality that are consistent with the Na⁺-retaining actions of PRL. At the time of this study, we did not know whether GHRH/KP-102 treatment would affect GH levels in catfish, thus these results were difficult to interpret. Recently, we have developed a homologous ELISA (with collaborators) to measure plasma GH levels in channel catfish. Our findings demonstrate that transfer of catfish to

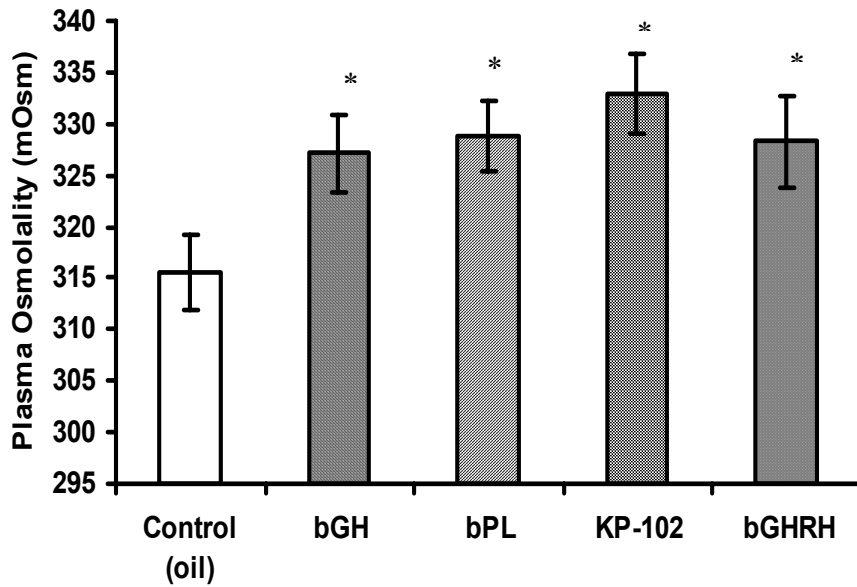


Figure 1: Effects of hormone treatment on plasma osmolality in channel catfish transferred to 15 ppt seawater. Values are means \pm SEM (n = 20/treatment). *P < 0.05 compared with control value (Fisher's Protected Least Significant Difference Test).

15 ppt SW elicits an increase in plasma GH levels that are further augmented (in FW or 15 ppt SW) by treatment with the GH secretagogues (Figure 2). In this study, plasma GH levels and plasma osmolality were elevated suggesting that native and/or heterologous GH may bind to the catfish PRL receptor, thus eliciting a PRL-like response. While this hypothesis is untested, it is somewhat analogous to findings wherein the variant form of tilapia prolactin (tPRL₁₇₇) was shown to bind to the tilapia GH receptor (Shepherd *et al.*, 1997). This possibility, and others, will be examined in future studies.

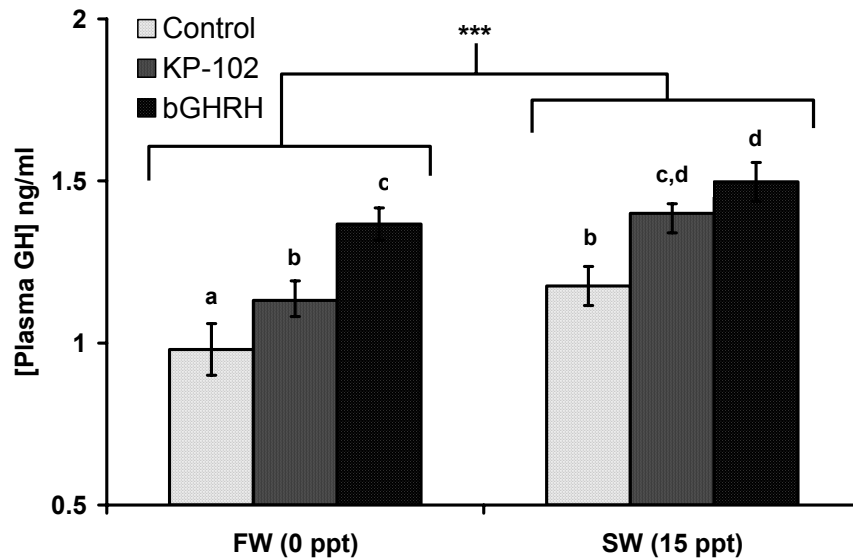


Figure 2: Effects of environmental salinity and GH secretagogues (KP-102 and bGHRH) on plasma GH levels in channel catfish. Plasma GH levels were determined using a homologous ELISA. Values are means \pm SEM ($n = 20/\text{treatment}$). *** $P < 0.005$, FW vs. 15 ppt SW groups (two-way ANOVA). Groups with different letters are significantly ($P < 0.05$) different (Fisher's Protected Least Significant Difference Test).

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